

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

## PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To:

see Form PCT/ISA/220

Date of mailing  
(day/month/year) see Form PCT/ISA/210 (sheet 2)

Applicant's or agent's file reference  
see Form PCT/ISA/220

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No.  
PCT/EP2004/004845

International filing date (day/month/year)  
06.05.2004

Priority date (day/month/year)  
08.05.2003

International Patent Classification (IPC) or both national classification and IPC  
H03M7/00, H03K7/00

Applicant  
LITEF GMBH

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1 (a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires earlier.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.  
PCT/EP2004/004845

10/522/16

Box No. I. Basis of this opinion

JC23 Reclat GIV 07 NOV 2005

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.  
☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material  
☐ a sequence listing  
☐ table(s) related to the sequence listing
  - b. format of material  
☐ in written format  
☐ in computer readable form
  - c. time of filing/furnishing  
☐ contained in the international application as filed  
☐ filed together with the international application in computer readable form  
☐ furnished subsequently to this Authority for the purposes of search
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

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Box No. II. Priority

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1. ☒ The following document has not yet been furnished:

☒ copy of the earlier application whose priority has been claimed (Rules 43*bis*.1 and 66.7(a)).

☐ translation of the earlier application whose priority has been claimed (Rules 43*bis*.1 and 66.7(b)).

Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

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Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

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1. Statement

Novelty	Yes: Claims	1 to 31
	No: Claims	NONE
Inventive Step	Yes: Claims	1 to 31
	No: Claims	NONE
Industrial Applicability	Yes: Claims	1 to 31
	No: Claims	NONE

2. Citations and explanations:

see separate sheet

80/522716  
JC20 REG/PGT/PTO 07 NOV 2009

Re Item V.

1 The following documents are referred to in the present decision:

D1: US 6 317 468 B1 (MEYER RONALD R) November 13, 2001 (2001-11-13)

D2: TAO H ET AL: "A 400-MS/S FREQUENCY TRANSLATING BANDPASS SIGMA-DELTA MODULATOR" IEEE JOURNAL OF SOLID-STATE CIRCUITS, IEEE INC. NEW YORK, US, Volume 34, No. 12, December 1999 (1999-12), pages 1741-1752, XP000932504 ISSN: 0018-9200

### Subject matter of the invention:

A pulse modulator for conversion of a complex input signal (I, Q) to a pulsed signal, in which the spectral distribution of the quantization noise can be flexibly adapted.

### Closest prior art

D1 discloses (see Figure 2-4 and column 4, line 23 - column 5, line 18) a pulse modulator (see Figures 2 and 3) for conversion of a complex input signal (I, Q) to a pulsed signal (Y(Z) in Figure 3) having

- a first multiplication stage (34, 36, 38), which multiplies the complex input signal by a complex mixing signal oscillating at an IF carrier frequency (see column 4, lines 24-34), and thus produces the real part (X(Z) in Figure 3, see also column 4, lines 35-49) of an input signal up-mixed by the IF carrier frequency;
- a bandpass sigma-delta modulator (40) which quantizes the real part of the input signal up-mixed by the IF carrier frequency; which sigma-delta modulator (40, Figure 3)
  - has a subtraction stage (Figure 3, stage on the left of Figure 52), which produces a control error signal (input signal of 52) from the difference between the real part (X(Z)) and a feedback signal (58);
  - has a signal conversion stage (52, 54), which converts the control error signal to a control signal (output signal from 54);
  - has a quantization stage (50) which quantizes the control signal and thus produces the pulsed signal (Y(Z));
  - and has a feedback unit (56, 58), which uses the pulsed signal (Y(Z)) to

produce the feedback signal (58) for the subtraction stage.

**Objective aim:**

How else could a pulse modulator be used to convert a complex input signal (I, Q) to a pulsed signal in which the spectral distribution of the quantization noise can be flexibly adapted (see page 1, lines 31-33).

**Solution:**

With a bandpass sigma-delta modulator in which the first multiplication stage is arranged between the signal conversion stage and the quantization stage, such that the subtraction stage produces a *likewise complex* control error signal from the difference between *the complex input signal* and the feedback signal, the signal conversion stage converts the complex control error signal to a *complex* control signal, and in that the complex control signal is first of all up-mixed by the IF carrier frequency, and the real part of the up-mixed control signal is quantized by the quantization stage.

**Notes relating to novelty and inventive step:**

This solution is not known from D1, and is also not suggested in that document. The object of being able to flexibly adapt the spectral distribution of the quantization noise is likewise not mentioned in D1, but would be achieved automatically in a similar manner simply by changing the IF carrier frequency. The pulse modulator according to D1 has an entirely different design, however, as a result of which the solution from D1 departs from the solution offered in the application, and D1 would give a person skilled in the art no indication of why he should position the first multiplication stage in the loop of the sigma-delta modulator. A combination of D1 with D2 does not make the solution obvious, either. The subject matter of the two independent claims 1, 21 and 31, which are mutually matching equipment, method and computer program product claims, thus satisfies the requirements of Article 33(2)-(3) PCT with regard to novelty and inventive step. Claims 2-20 and 22-30 add further features to the independent claims 1 and 21, respectively, and thus likewise satisfy the requirements of the PCT with regard to novelty and inventive step.

**Further documents cited in the International Search Report**

D2 describes a pulse modulator for conversion of an analog input signal to a complex output signal, whose real part and imaginary part are both pulsed signals (see Figure 3 or 4), having a complex analog cascaded sigma-delta modulator in which the control signal is down-mixed by a mixing stage arranged in the forward path of the main loop, and the two pulsed signals are produced by two internal sigma-delta modulators. The object is also not known from this document, neither would a person skilled in the art be given any indication to restrict himself to only one of the two parts of the complex signal, and thus to reach the solution in the application.

**Further comments relating to the claims**

Since the only common feature between D1 and the subject matter of claims 1, 21 and 31 is the general structures of the sigma-delta modulator and of the mixer, it is regarded as being permissible to word the claims in the single-part form.